Integrating Energy Conservation into Operations & Maintenance

May 11, 2011

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Section 1 - Introduction

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Discussion Points

- Most O & M Personnel don't have time to be concerned about energy – they are trying to keep the place running!
- Fact is: there is between 10% and 20% energy savings available that is low cost or no cost
- You don't need expensive commissioning agents to do this work – most work can be accomplished through service orders
- The O & M Folks are in the field every day and they have the ability to make this happen

Section 1 - Introduction

- Rule: You can not save more energy than you consume
- There are only 3 ways to save energy

$$\text{Energy} = \frac{\text{(Load)}}{\text{(Efficiency)}} \times \text{(Operating Hours)}$$

  - Reduce load, reduce operating hours
  - Increase efficiency
- There are 5 ways to reduce energy costs (switch fuels or change rates)

Section 2 – Cooling Systems

Section 2 – Cooling Systems

- Raising chilled-water temperature saves energy
- Watch dehumidification requirements

Machine Type	Chilled Water Temperature Increase (°F)							
	1°F	2°F	3°F	4°F	5°F	6°F	7°F	8°F
Centrifugal	1.6%	3.2%	4.8%	6.4%	8.0%	9.6%	12.8 %	16.0 %
Absorption	0.8%	1.6%	2.4%	3.2%	4.0%	4.9%	6.5%	8.1%

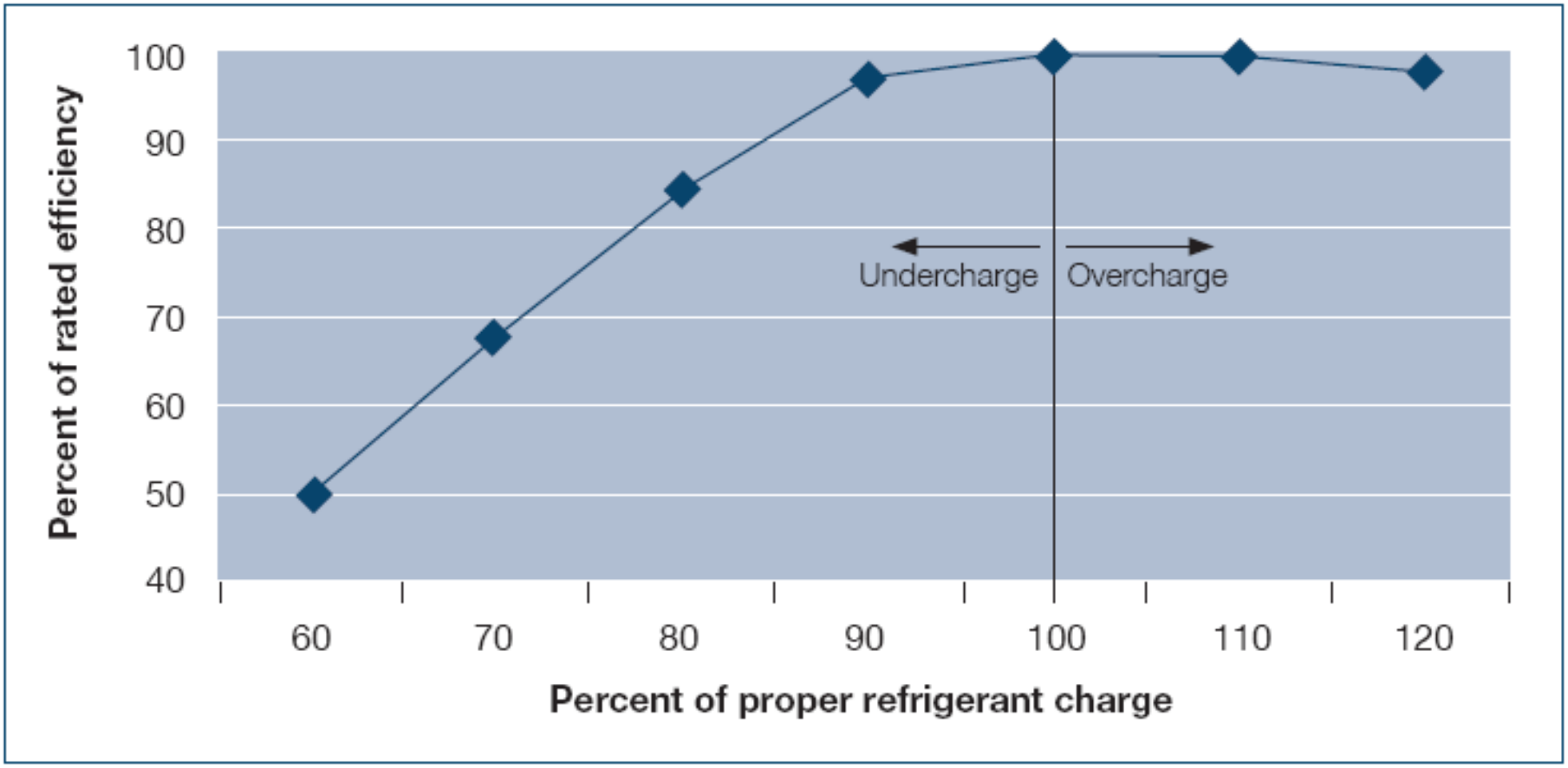
Section 2 – Cooling Systems

- Lowering condenser-water temperature saves energy
- Watch chiller limitations

Machine Type	Condenser Water Temperature Reduction (°F)							
	1°F	2°F	3°F	4°F	5°F	6°F	7°F	8°F
Centrifugal	1.1%	2.2%	3.3%	4.4%	5.5%	6.6%	7.7%	8.8%
Absorption	0.5%	1.1%	1.6%	2.1%	2.6%	3.2%	4.2%	5.3%

Section 2 – Cooling Systems

- Verify proper refrigerant charge



Section 2 – Cooling Systems

Consider a Waterside Economizer if:

a. You have a water cooled chilled water plant.

b. You have to cool into the winter months and the outside air is consistently below 60 deg. F.

c. You don't have an air side economizer.

Section 2 – Cooling Systems Action Plan

1. Check the refrigerant charge against the manufacturers recommendations on the larger systems, check the smaller systems through service calls or routine maintenance.
2. Implement condenser water reset w/VSD's on fans (check with chiller manufacturer for limits).
3. Consider chilled water reset if you do not have significant humidity problems or utilize in the Spring and Fall only.

Section 3 – Heating Systems

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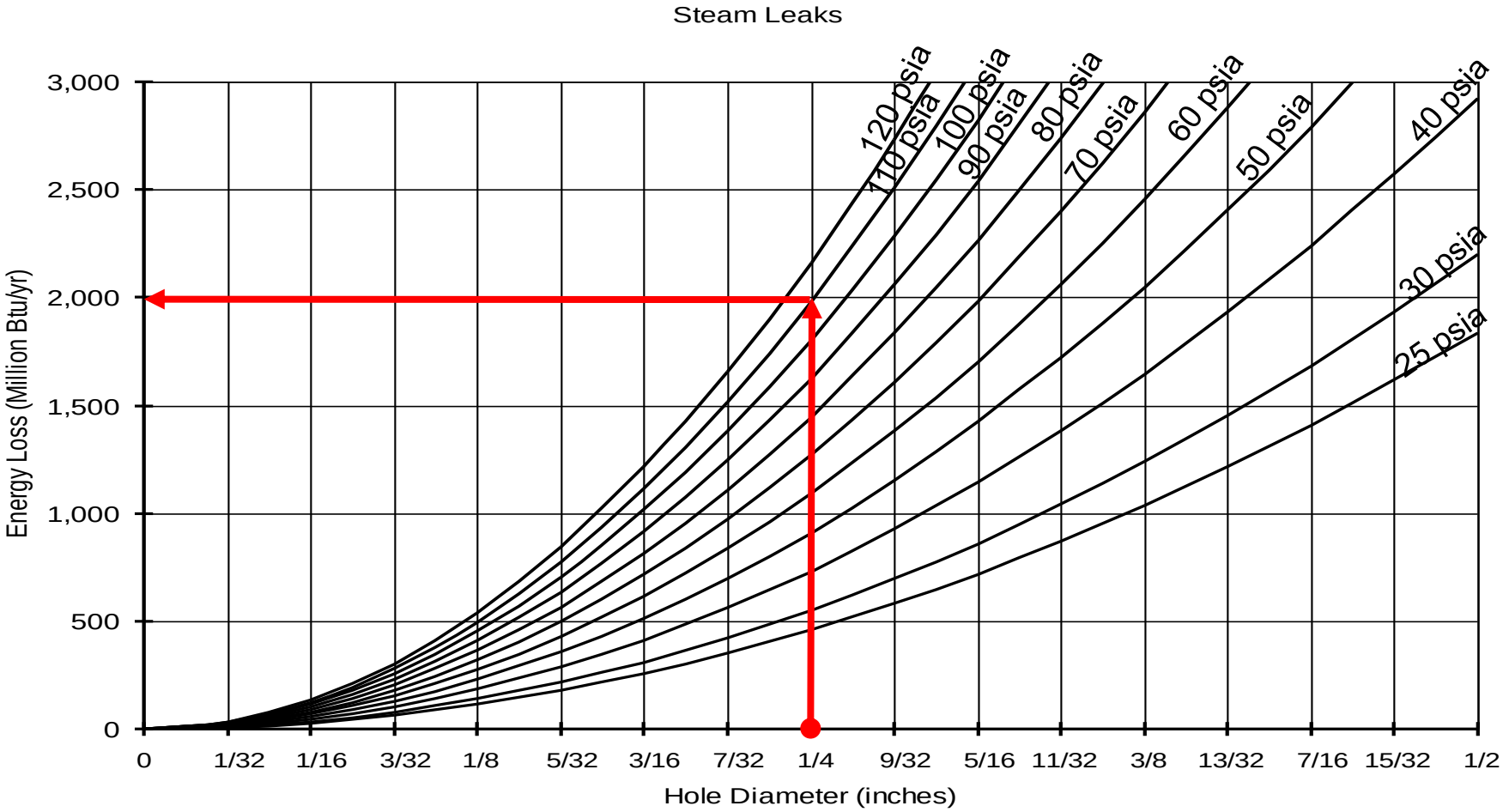
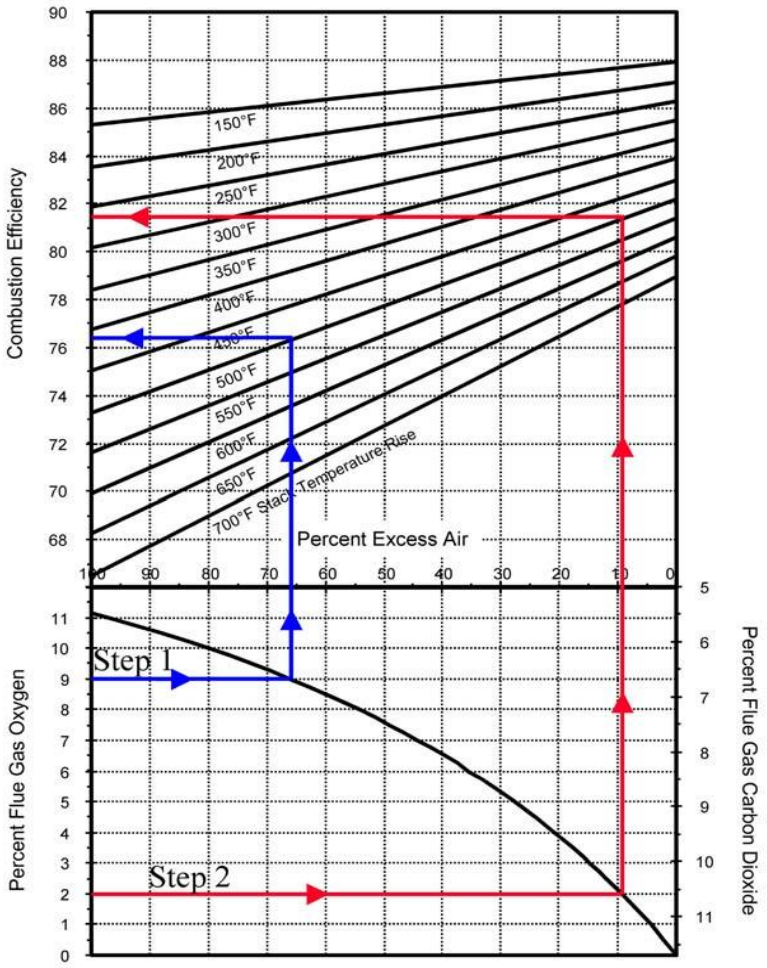
- Repair Steam Leaks



Section 3 – Heating Systems

- Reduce excess air
- Provide sufficient air for combustion (check CO_2 & O_2)
- 1% to 2% O_2 in flue gas is optimum



Section 3 – Heating Systems

- Reduce steam pressure/hot water temperature
- Reduce boiler blow-down
- Shut off steam tracers during summer (electric heat tape too!)

Section 3 – Heating Systems

- Purpose of a steam trap
  - Allow condensate and air to pass through the trap
  - Retains the steam
- Steam traps have a high failure rate
- Checking for failed steam traps
  - Signs (steam rising from vents and drains)
  - Sight (watch the discharge – no return)
  - Sound (listen to the operation)
  - Temperature (monitor the delta T) H/H, H/C & H/W

Section 3 – Heating Systems

- Utilize a hot water reset schedule (vary hot water temperature based on outside air)

Typical Hot Water Reset Schedule

Outside Air Temperature (F)	60	50	40	30	20	10	0
Hot Water Supply Temperature (F)	100	115	130	145	160	170	180

Section 3 – Heating Systems Action Plan

1. If you have a steam boiler:
   a. Check A/F Ratio at the start of the season.
   b. Make sure all steam traps are working.
   c. See if you can lower steam pressure (check requirements at the farthest location).
2. If you have a hot water boiler:
   a. Check A/F Ratio at the start of the season.
   b. Vary supply water temperature based on OA temperature.
3. Repair all distribution leaks ASAP.

Section 4 – Air Handling Systems

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You need to know what you have and how it is supposed to operate !

- Single Zone, Constant Volume
- Dual Duct
- Multizone
- VAV
- Perimeter Induction Units

General O & M - check economizers, dampers, control valves, etc… for proper operation

Section 4 – Air Handling Systems

- Inspect ductwork for leaks & repair
- Replace filters when required (monitor dP)
- Consider night ventilation to offset cooling (swing seasons)
- Shut down non - interlocked exhaust fans at night if not required.

Section 4 – Air Handling Systems

Energy Savings Control Strategies for AHU's

- Static pressure reset
  - Lower the static pressure when you can
  - Fan power = f_x {pressure, flow, 1/efficiency}
- Night setup/setback
- CO_2 based ventilation
- Maximize economizer use
- Shut down AHU's/or OA dampers to unoccupied spaces (start/stop)
- Occupancy sensor controlled VAV Boxes

Section 4 – AH Systems Action Plan

1. Know how your systems are supposed to operate & verify operation.
2. Use night setup/setback.
3. Investigate using static pressure reset if applicable or demand controlled ventilation
4. Maximize economizer use.
5. Shut down AHU's/or OA dampers to unoccupied spaces & shut down non - interlocked exhaust fans at night if not required.
6. Replace filters based on differential pressure.

Section 5 – Electric Motors & Drives

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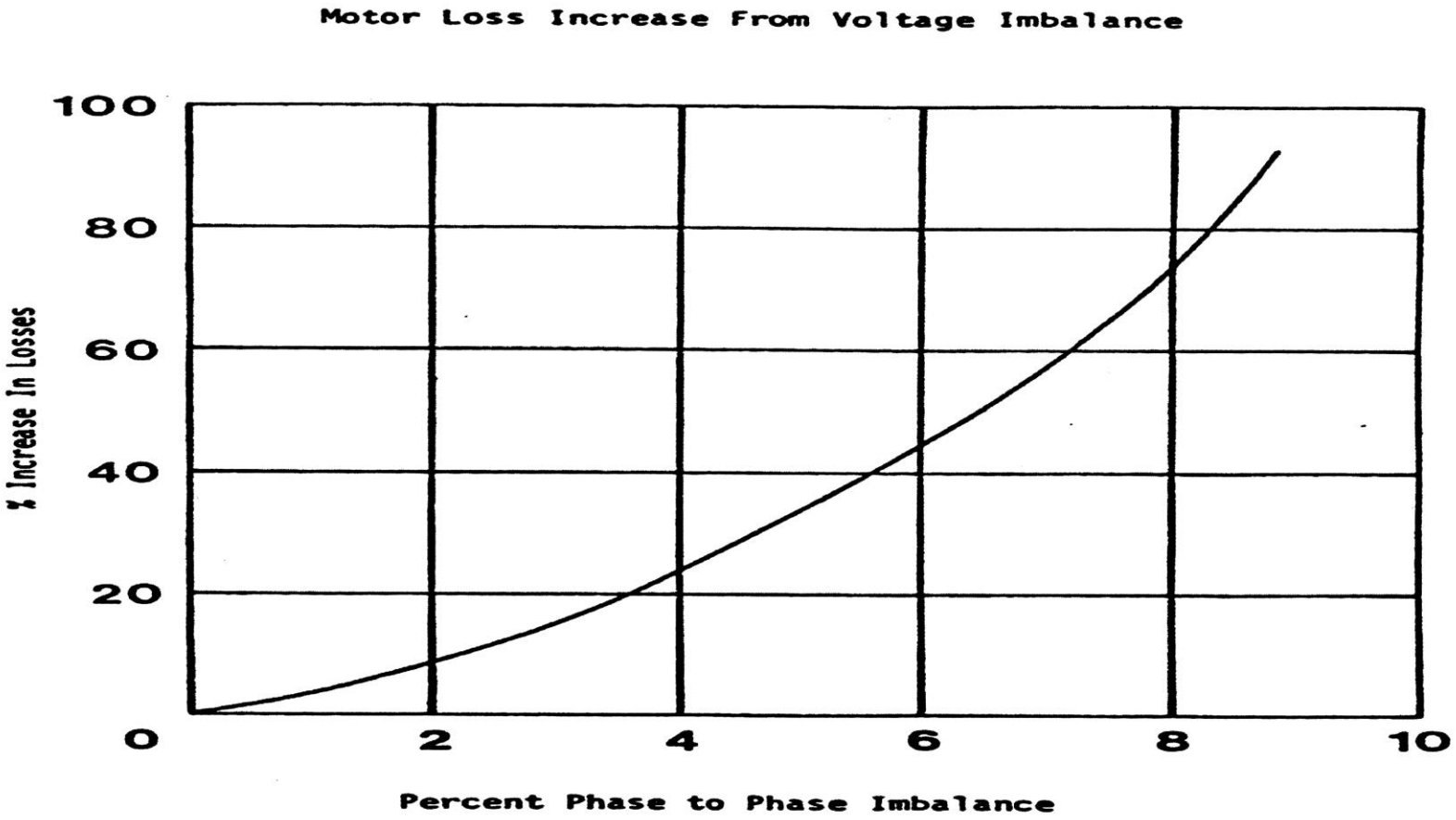
- Do not oversize motors
- Match motor speed to flow requirement
  - Change pulley ratio if possible (less work = less energy)
- Specify energy-efficient (cogged) v-belts for belt drive applications
- Buy/specify premium-efficiency motors instead of rewinds

Section 5 – Electric Motors & Drives

- Check for voltage imbalance



Section 5 – Electric Motors and Drives

VSD Applications (for motors over 5 HP)

- Secondary Chilled & Hot Water Pumps
- Cooling Tower Fans
- Domestic Water Booster Pumps
- Variable Air Volume Fans (supply & return)

Section 5 – Motors & Drives Action Plan

1. Use energy-efficient (cogged) v-belts (with soft starts).
2. Specify premium-efficiency replacement motors (use inverter duty motors with variable speed drives).
3. Properly size motors and sheaves for the correct speed.
4. Review your equipment inventory for VSD applications (5 HP and above).
5. Check for voltage imbalance.

Section 6 – Lighting

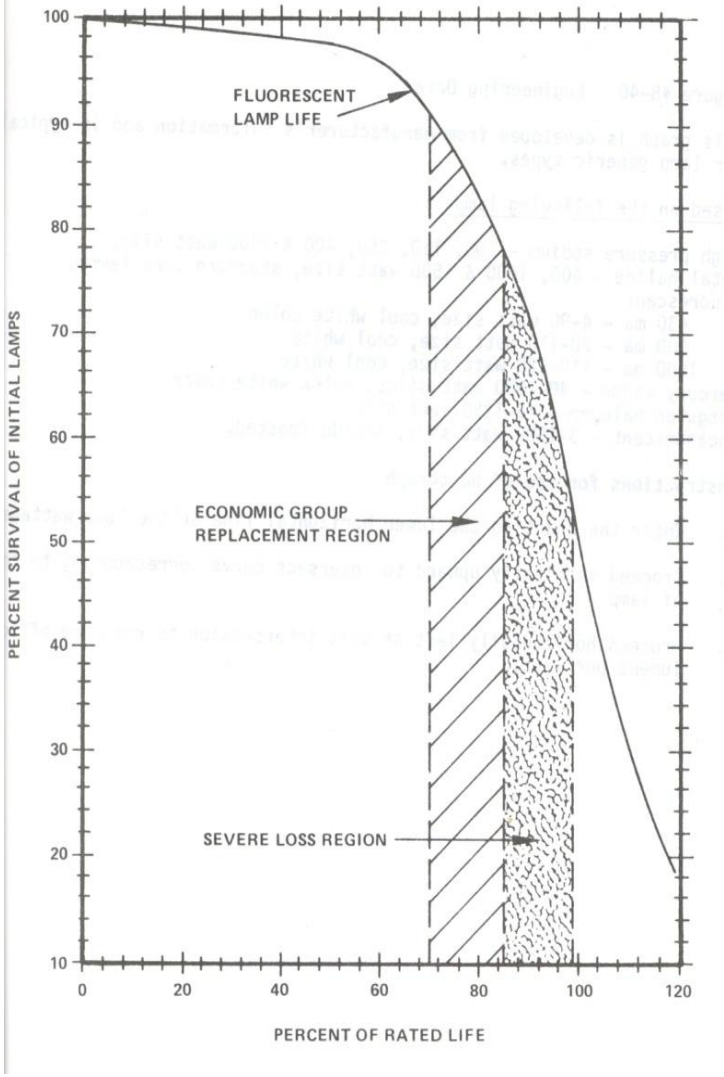
Section 6 – Lighting

- Retrofit all 4 foot T-12 fixture with T-8's and electronic ballasts
- Exit lights (LED)
- Don't over light stairwells and other common areas
- Occupancy sensors (4-4 foot fixtures or more)
- Day-lighting controls (exterior spaces/expensive)
- Multi-level switching/individual switching
- Photocell controlled exterior lighting
- Task lighting

Section 6 – Lighting

Group Relamping

- Saves labor
- Improves light levels
- Control disposal of lamps
- Don’t forget to clean the fixture



Section 6 – Lighting Action Plan

1. Buy a light meter and an IESNA Lighting Handbook.
2. Check stairwells and other common areas for over lighting.
3. Make sure T-8 lamps and electronic ballasts are used in all fluorescent fixtures – retrofit all T-12 lamps and magnetic ballasts.
4. Replace incandescent and fluorescent exit signs with LED exit signs.
5. Verify exterior lighting is controlled by photocells.
6. Use occupancy sensors in conference rooms, large offices and large bathrooms with 4 fixtures or more.
7. Utilize Group relamping when possible.

Section 7 – Compressed Air

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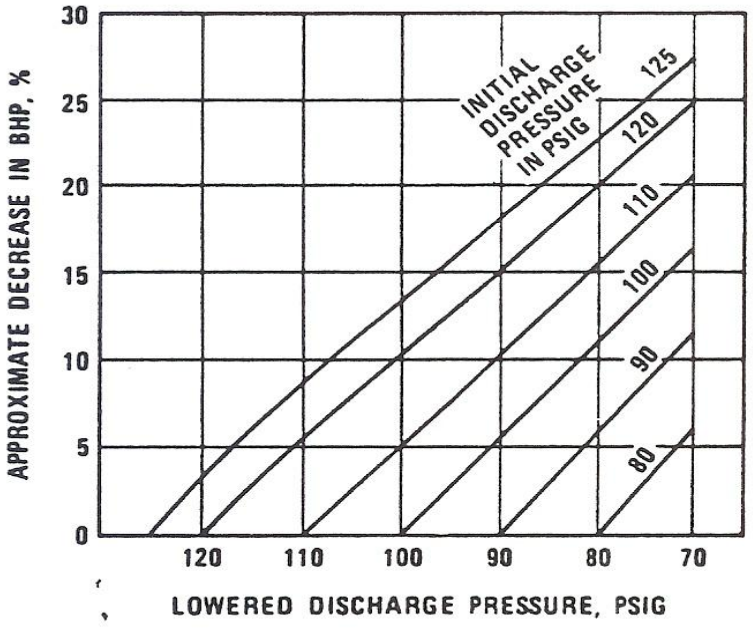
Repair Compressed Air leaks

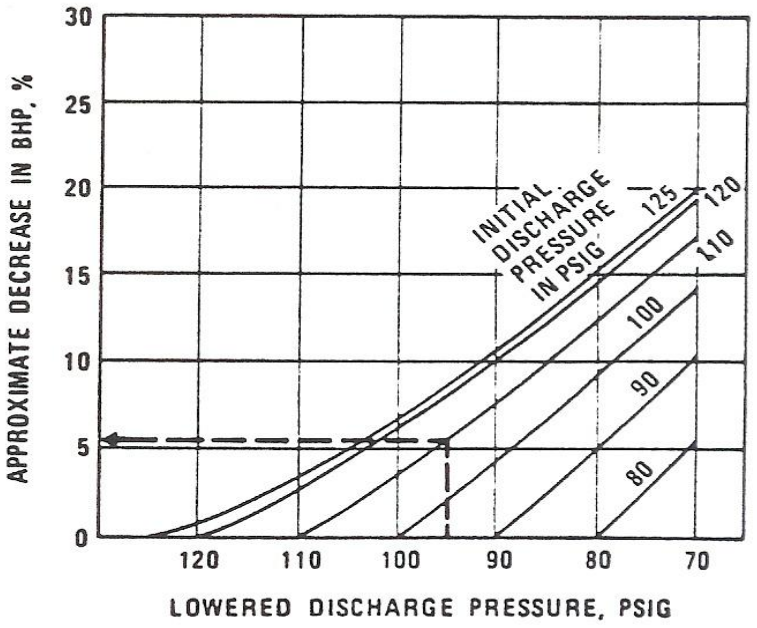
Cost of Compressed-Air Leaks			
Equivalent Hole Size (inch diameter)	Energy Loss (kWh/yr)		
	110 psig	100 psig	90 psig
3/8	226,100	208,100	190,000
1/4	100,500	92,500	86,300
1/8	25,100	23,100	21,100
1/16	6,300	5,800	5,300
1/32	1,600	1,400	1,300

Section 7 – Compressed Air

Minimize the maximum pressure



Single–Stage Reciprocating and Rotary Screw Compressors[24, 28]



Two–Stage Reciprocating and Centrifugal Compressors[2]

Reference: Energy Conservation Program Guide for Industry and Commerce, NBS Handbook 115, Department of Commerce, Washington DC. 1974.

Section 7 – Compressed Air

Provide cooler intake Air

Relocate air intakes to cooler locations	
Air Intake Temp, °F	Power Savings, %
30	7.5
50	3.8
70	0
90	(3.8)
110	(7.6)

Reference: Energy Conservation Program Guide for Industry and Commerce,
NBS Handbook 115, Department of Commerce, Washington DC. 1974.

Section 7 – Compressed Air Action Plan

1. Eliminate leaks!!!
2. Turn off compressors when not needed.
3. Reduce line pressure to minimum required
4. Locate compressor intakes away from heat sources or duct to the outside.
5. Check pressure regulators (reduce pressure if possible).

Section 8 – Closing Remarks

- O & M Folks are your eyes and ears in the field, use them to indentify energy saving opportunities
- Most of these recommendations are service order scope, few might be IDIQ level
- For those re-competing a contract, consider adding an energy savings incentive paragraph in the contract

Section 8 – Closing Remarks

Questions ?

Section 8 – Closing Remarks

Contact Information

Pete Aitcheson

O & M Program Manager

NASA HQ

(202) 358-0971

peter.c.aitcheson@nasa.gov